Appetite: Journal for Intake Research 1981, 2, 217–229

A Psychophysical Analysis of Perceived Satiety: Its Relation to Consumatory Behavior and Degree of Overweight

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The psychophysical technique of cross-modal matching was used to scale perceived satiety. In three experiments, a total of 108 subjects matched the changing level of perceived satiety by adjusting the length of a metal tape at 2-min intervals while eating a fixed-amount meal and filling out a questionnaire afterwards. Perceived satiety rose linearly during the meal at a rate of 4% a minute, reaching 40% of maximum satiety in the 6-min meal time. Perceived satiety fell after the meal at a rate of 1% a minute for at least 10 min. Normal weight subjects did not differ from overweight subjects in initial satiety level or in the rate at which satiety changed either during or after the meal. The close tie between perceived satiety and the act of eating points to the importance of consummatory behavior in determining feelings of satiety; the slow fall of satiety after the meal indicates that it is also dependent on internal states that persist after eating. Thus satiety seems to depend both on oropharyngeal cues and on some quickly occurring but relatively long lasting internal changes caused by ingestion. Longer-term changes in satiety following ingestion remain to be assessed.

Studies of the events that control feeding behavior have generally employed infrahuman subjects, and perhaps for this reason, psychological perspectives have been relatively neglected even while the physiology of ingestion is becoming increasingly better understood. Little is known about how experiences of hunger and satiety, the subjective correlates of physiological processes, are related to such factors as amount and rate of food ingestion and time since the termination of ingestion.

Such knowledge is important for several reasons. First, it can provide a test of the view offered by Stunkard (1975) that, in humans, the feeling of a full stomach is the immediate (conditioned) cue for terminating ingestion, a suggestion that discriminated degrees of satiety control eating behavior. Second, the discriminability of internal stimuli is thought to play a role in eating disturbances, both anorexia and the overeating that results in obesity (Schachter, 1968). Third, if it can be shown that observers are capable of graded, reliable judgments of their own feelings of satiety, a new tactic becomes available for behavior modification of eating. Whereas current

This research was carried out while the first two authors were NRC-NSF Resident Research Associates at the U.S. Army Natick Research and Development Command. The first author is now at Smith College; the second author is at Pepsico, Inc., Valhala, NY; the third author, at Clark University. A report of Experiment 1, titled Perceived Satiety During and After a Meal, was given at the IVth International Conference on the Physiology of Food and Fluid Intake, Paris, France, 1977. We are most grateful to the Natick Food Acceptance Laboratory for their generosity in making their facilities available and for providing advice and support. We are also grateful to H. Jacobs and R. Teghtsoonian for their careful readings and helpful comments on this paper.

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0195-6663/81/030217+13 $02·00/0

techniques emphasize the control that external stimuli exert on eating behavior (see, for example, Ferster, Nurnberger & Levitt, 1962; Stuart, 1971), a complementary approach is to bring eating under the control of discriminable internal events. If normal weight individuals use these cues to modify eating behavior, perhaps over- and underweight persons can learn to do so as well.

The Assessment of Perceived Satiety

Early efforts to obtain subjective judgments of hunger or satiety have relied on relatively crude measurement techniques, such as simple informal description (Mayer, Monello & Selzer, 1965) or two-valued scales of "hungry–not hungry" (e.g. Silverstone & Russell, 1967; Stunkard & Koch, 1964). Later studies have employed category scales (e.g. Jordan, Wieland, Zebley, Stellar & Stunkard, 1966; Stunkard & Fox, 1971), which constrain the range and number of the subject's responses. There are, however, more recently developed psychophysical techniques that may allow ratio scaling of the sensations associated with satiety. These cross-modal matching methods call for the subject to adjust or select intensities on one perceptual continuum—the judgmental—to achieve matches of perceived magnitude with experimenter-selected values on another—the target—continuum. The most familiar version of this technique is called magnitude estimation and entails the use of numbers as the judgmental continuum. It has yielded reliable and widely accepted scales of loudness, brightness, and many other perceptual continua (Stevens, 1975). And it is well-established that the use of continua other than number—such as force of handgrip, or sound-pressure level, or length of line—for the expression of subjects' judgments leaves unchanged the relation among the resulting scales.

Despite the successful application of cross-modal matching methods to a large and varied assortment of perceptual scaling problems, a number of questions might be raised *a priori* about the suitability of these techniques for the measurement of perceived satiety. For one thing, most of the well-studied cases such as loudness and brightness focus on some clearly definable stimulus—a tone or a light—in the external environment, whereas the stimuli defining perceived satiety, whatever they may be, are part of the subject's internal environment. There does exist, however, at least one analogous case, perceived effort, which also must be governed by a complex of internal events, that nonetheless has been successfully scaled in a number of different laboratories (Borg, 1976). All that has been necessary is the identification of such variables as work load, duration of effort, and strength of the subject, that can be shown to be parameters of the subject's judgments of perceived effort. Similarly, it is an empirical question whether such variables as amount consumed and rate of consumption are related in an orderly way to judgments of perceived satiety obtained by cross-modal matching.

Another question might be raised about the plausibility of scaling a stimulus, satiety, when no associated physical measures are available, as is the case when the physiological changes thought to underlie states of hunger and satiety are not assessed in a particular experiment. However, the absence of a physical metric on the stimulus does not make scaling impossible; as long as the events to be scaled are discriminable from each other, then nothing prevents us from requesting ratio scaling responses from the subject. Indeed, several such scales have been constructed, including scales of the seriousness of crimes and the severity of punishments (Sellin & Wolfgang, 1964) and the emotional impact of events as a function of how far in the future they occur (Ekman &

Lundberg, 1971) [for a review of this work, and the logic underlying it, see Stevens (1975)].

A question might also be raised about the assumption that subjects will judge satiety when asked to. The form of the request is not unique to our study: the description of adaptation effects by cross-modal matching is analogous. For instance, when the subject holds a salt solution in his mouth for several minutes, and his magnitude estimations of saltiness are requested at intervals, the resulting subjective responses are plotted against elapsed time (since the stimulus concentration does not change) and are interpreted as evidence of sensory adaptation even though no measurement is made of changes in neural activity of taste receptors (e.g. Meiselman, 1968).

Currently accepted procedures suggest that it is plausible to ask the subject to judge how full or how hungry he feels. In fact, in a number of published studies, ratings of hunger have served as the dependent variable, and the subject's reports accepted as an indication of a subjective state. For example, Silverstone and Stunkard (1968) and Thompson and Campbell (1977) had subjects indicate degree of hunger by marking a location on a line; in both studies, the ratings were sensitive to the administration of an appetite-changing substance and to the ingestion of food, providing validation of the assumption that subjects were reporting what they were asked to report.

Our primary purpose in the studies reported here was to develop a version of cross-modal matching that could be used easily to scale perceived satiety while the subject was, e.g. eating, reading or writing, or talking, without disrupting those performances, so that we could obtain a detailed description of the course of perceived satiety during and after a meal. In three experiments, the subject ate a test meal and filled out a questionnaire, repeatedly matching the changing level of her/his subjective feelings of satiety by adjusting the length of a steel tape.

Target Continuum

We assumed that people are more or less aware of satiety levels. Just as someone can tell whether he is working a little or working pretty hard—that is, he can discriminate sensory concomitants of physical exertion—so too, he can tell whether he is only a little full or very full—that is, he can discriminate sensory concomitants of satiety. Our tactic, then, was to vary satiety by having subjects eat a test meal and to measure subjects' feeling of satiety by having them adjust the length of a steel tape to show how full they felt before, during, and after a meal.

In phrasing our instructions, we were forced to make a guess as to whether subjects regard hunger and satiety as inverse continua (like bigness and smallness, or loudness and softness), or as two continua of the sort that there can be a positive value on one only when there is a zero value on the other (like perceived warmth and cold). It might be that, when one says one is most sated, one also says one is least hungry, and when least sated, hungriest. Or it may be that when one is not hungry, satiety may vary, and when one is not sated, hunger may vary. We opted for the first alternative, and our instructions asked the subject to set a length to indicate what was the least full he could imagine feeling, and another length to indicate the most full; all satiety settings had to range between these two positive values. (The alternative would have been to require him first to say whether he felt hungry or full, which specifies a zero value on the other continuum, then to make a length setting to indicate the magnitude of the feeling.)

The Response Continuum

Subjects may be asked to assign numbers to match sensations, in the method of magnitude estimation. However, this is only one form of cross-modal matching, in which the subject is required to match values on a response continuum to values on a target continuum—to make the loudness of a sound, for example, correspond to the perceived force of a given handgrip, or the length of a line correspond to the brightness of a light. We chose to have our subjects use length rather than number as the response continuum to indicate degree of satiety. Numbers, being easily remembered, might be used by the subject to reflect not only his feelings of satiety, but his preconceptions of what he should feel, during a meal. Lengths are harder to remember, and we believed that each length-satiety match would therefore be more directly perceptual. However, length matches are easily converted to numerical equivalents, since it is well-established that a linear function relates matches between length and number (Stevens & Guirao, 1963; Teghtsoonian, 1965).

The General Design

In each of the three experiments to be reported, subjects made length matches to satiety at 2-min intervals while eating a meal and filling out a questionnaire designed to require about 15 min to complete. Information obtained included ratings, on a five-point scale, of acceptability of the meal and its quantity compared to that normally eaten, and subject's present height and weight.

It has been argued (Mayer, 1966, 1968) that satiety lags behind ingestion and reaches maximum after the meal is completed. This suggests that slowing down the meal sequence, e.g. by delaying dessert until subjective satiety is maximal, would decrease the desire for after-dinner sweets. To test this hypothesis, in Experiment 1 a plate of cookies was presented at three different times after meal completion for three groups of subjects.

The subjects in Experiments 1 and 2 were men; women subjects were used in Experiment 3 to see whether there were gender differences in patterns of perceived satiety.

METHOD

Since the general procedure and analyses of results were the same for all three experiments, they are reported together.

Subjects. Subjects were participants in the Taste Panel of the Food Acceptance Laboratory at the U.S. Army Natick Research and Development Command, who had previously agreed to participate in an ongoing program for testing food acceptance. Subjects in Experiment 1 were 44 males between the ages of 21 and 62; in Experiment 2, 40 males, ages 21 to 63; and in Experiment 3, 24 females, ages 20 to 61.

Apparatus and Materials. Each subject sat facing a testing booth; four such booths were arranged side by side along a counter in a single room, separated from each other by counter-to-ceiling walls. A retractable metal tape measure was mounted to each subject's right and above his head, so that it could easily be pulled down to lengths ranging from 1 to 150 cm. Only the featureless back of the tape could be seen by the subject; the experimenter read the setting from the front of the tape and reset it to zero after each reading. Each booth contained a sliding panel into a kitchen area through which food was passed.

The test meal was a commercial frozen meat loaf dinner, containing meat loaf in tomato sauce, mashed potatoes, and green beans. The manufacturer specified the meal contained 312 g (20·9 g protein, 23·7 g fat, and 29·0 g carbohydrate) and 412 calories. The meal was prepared according to the instructions on the package and presented to the subject with salt and pepper and a glass of water. The cookies in Experiment 1 were a commercial brand of fudge cookie.

Procedure. Subjects were scheduled in groups of four. They arrived at noon, close to normal lunch time in the work setting. They were seated at the booths and given the following instructions to read:

> "We have asked you to take part in this study because we want to find out how people's feelings of hunger and satisfaction change before, during, and after a meal. We'll ask you to eat a lunch we'll provide, and then answer some questions about your food preferences, and from time to time, we'll ask you to make a judgment of how full, or how satisfied, you feel.
>
> Sometimes you may feel 'so empty you could eat a horse'; at another time, you may feel 'so full you couldn't eat another bite'. Most of the time, of course, you're somewhere in between. At various points in the next half-hour, we'll ask you to tell us just how full you do feel at the moment. You'll do this by adjusting the metal tape that's mounted on the partition to your right, by pulling it down to a length that indicates your fullness. If you're just a little bit full, you would pull the tape out to a short length; if you're feeling quite full, you would pull it out to a long length. And, however full you are feeling, you would make the length of the tape proportional to that feeling. You can make the tape as long or as short as you like—there are no upper or lower limits—so long as the length corresponds to your feeling of fullness."

The subject was then asked to set the tape to represent (1) feeling "really as full as you could be", (2) feeling "just not very full at all", and (3) "how full you feel right now". He was reminded that, whenever a buzzer sounded, both while he was eating and while he was filling out a questionnaire, he should set the tape to show "how full you feel right then". The instructions continued:

> "In a general way, you know that your feelings of fullness are related to how much and when you have eaten. But they may change up or down during a meal, depending on things like what you are eating, whether you are at the beginning or middle of a meal, and so on. So don't assume that you will just feel more and more full, because that won't necessarily happen; you may get less full, more full, or stay the same during parts of the meal."

The subject was told that all information was confidential and that the questionnaire was not identified with his name.

When the subjects had read the instructions, the meal was presented. At 2-min intervals, timed from the presentation of the meal, the buzzer sounded; subjects made length settings, which were recorded by the experimenter, who reset the tapes to zero at the same time. When a subject finished eating, he was given a questionnaire on food preferences and eating habits that was designed to require 15 min to complete. The buzzer continued to sound at 2-min intervals.

In Experiment 1 only, a plate of eight cookies was presented to each subject while he was working on the questionnaire. An accompanying card said, "Thank you for being a subject in this experiment. If you want, please help yourself to these cookies while filling out this questionnaire". For one group, the cookies were presented immediately after the meal; for a second group, 5 min after the meal ended; and for a third, 10 min. The number of cookies eaten during the first 5 min of availability was recorded.

Results

Almost all subjects ate the entire meal (occasionally some mashed potato was left); the average time required to finish was 6·2 min, with a standard deviation of 1·2, and a range from 4 to 9.

Satiety ratings. All subjects made length settings as requested without appearing puzzled or uncertain. Each was free to choose a range of lengths within which to express his perceived satiety: the minimum range selected by any subject was 13·75 to 24·5 in (34·5 to 62·5 cm), a ratio of maximum to minimum setting of 1·8; the maximum range was 1·0 to 69·0 in (2·54 to 175·3 cm), a ratio of 69. To take account of these differences, each subject's length matches were expressed as a percentage of the setting he made to indicate maximum satiety. Distributions of these percent maximum perceived satiety scores (which we will call perceived satiety) were neither normal nor log normal, though positively skewed. Consequently, the median was chosen as the measure of central tendency.

Figure 1 shows the changes in perceived satiety during and after the meal. The fitted lines, based on overall medians ($n=90$), have a slope of 3·4 (95% confidence limits $\pm$3·3) during the meal and $-1·2$ (with 95% confidence limits $\pm$0·6). On the average, subjects were at about 22% of maximum satiety at the beginning of the meal and showed a linear increase to about 42% in the 6 min required to consume the meal. Almost immediately after the meal, perceived satiety began to fall, in a roughly linear fashion, reaching about 36% after 10 min.

Individual subjects also showed roughly linear increases in perceived satiety as a function of time spent eating, and decreases in perceived satiety as a function of time

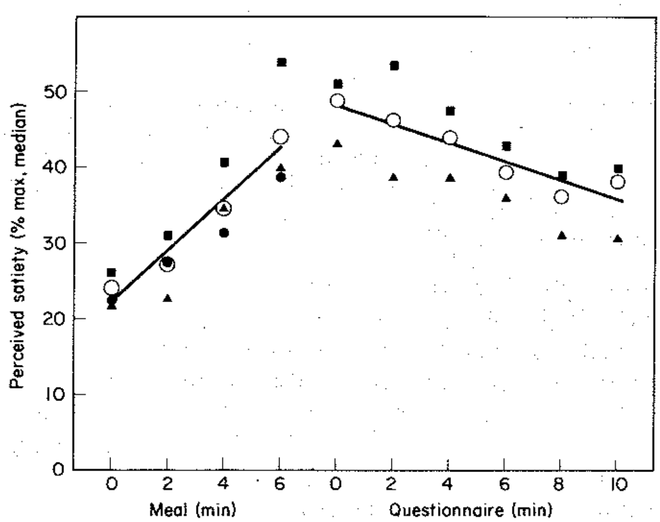

FIGURE 1. Changes in perceived satiety during and after a meal. Medians for the three separate experiments: ●, Experiment 1; ■, Experiment 2; ▲, Experiment 3; ○, medians for all three experiments combined ($n=90$). The lines are least square fits to the overall medians: during the meal, perceived satiety $=3·4t+22·2$; after the meal, perceived satiety $=-1·2t+48·0$.

after the meal. When individual satiety ratings are regressed on time in minutes since the meal (M) began,

$$\text{perceived satiety} = a_M + b_M \text{ time},$$

a high proportion of the variance, a median of 84%, is accounted for by the linear trend. The additive constant a_M represents the subject's perceived satiety at the beginning of the meal, his initial satiety level. The slope constant b_M represents the rate at which perceived satiety increases during the meal, the rate of growth of perceived satiety. Similarly, when perceived satiety is regressed on time since the questionnaire (Q) began, constants a_Q and b_Q are obtained; the linear trend accounts for a median of 48% of the variance. Neither during or after the meal do the deviations of satiety judgments from the fitted lines appear systematic. Figure 2 shows data from four typical subjects, chosen to span a range of a and b values.

The scores b_M were combined for the three experiments, and the distribution examined. With $n = 108$, the median was 3·2, the interquartile range 1·5–4·7. Following Tukey (1977), the limits defined by [median $\pm$ 1·5($Q_3 - Q_1$)] were taken. These were $-1·6$ and 8·0: seven percent of the individual slopes were less than $-1·6$; 9% were greater than 8·0. These deviant scores often depended on a single unusual judgment combined with fewer data points for that subject because he finished eating in 4 min. We have chosen to discard them because we believe they represent poor estimates of the individual functions. However, were they included, the conclusions based on inferential statistics would not be altered, since we have used non-parametric analyses that are relatively insensitive to outlying scores.

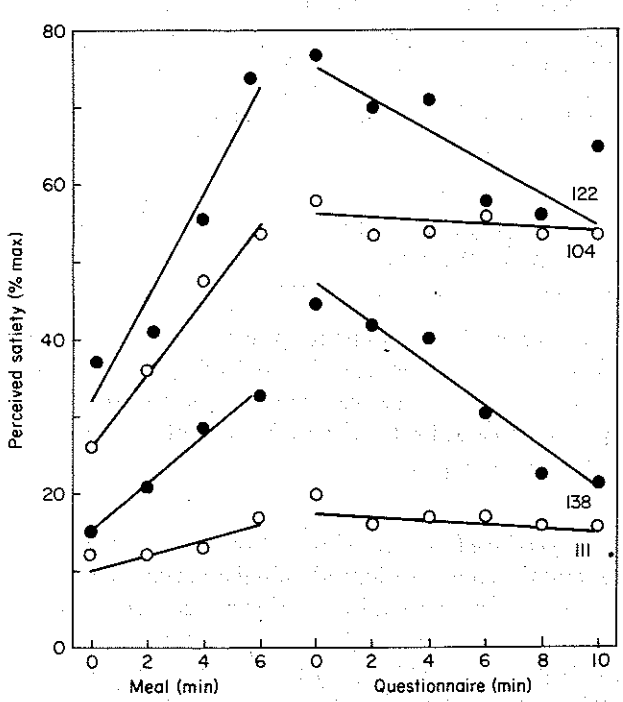

FIGURE 2. Changes in perceived satiety during and after a meal for four individuals.

TABLE 1
Constants of satiety functions (medians)

	Meal			Questionnaire		
Experiment	a_M	b_M	r^2	a_Q	b_Q	r^2
1	22·5	2·5	0·86	—	—	—
2	27·5	3·6	0·81	53	−0·25	0·45
3	21·5	2·6	0·84	40	−0·6	0·56
Combined	24	3·2	0·84	48·5	−0·45	0·48

Table 1 gives the median values, for 90 subjects, of a_M, b_M, a_Q, b_Q, and associated r^2's for the three experiments separately, and for all subjects combined; the constants do not differ among experiments (by U-test, $\alpha = 0{\cdot}05$). Figure 3 shows percent frequency distributions of the rate constant b_M. Although the range is considerable, three-quarters of the values fall between 1 and 5, and 96% are greater than 0. The overall median slope is 3·2. Figure 4 shows the percent frequency distributions of b_Q for Experiments 2 and 3 (since subjects in Experiment 1 ate cookies during the questionnaire, their results are not included). Three-quarters of the values fall between 0 and −4. When values are classified as greater than or less than 0, and a sign test used to evaluate the null hypothesis that $P = Q = 0{\cdot}5$, where P is the probability that a score is less than zero, $p < 0{\cdot}003$ by a two-tailed test. The overall median slope is −0·45.

Correlations between various aspects of individual functions showed that growth of satiety during the meal was independent of initial satiety level—between a_M and b_M, Spearman's rank order correlation $r_S\,(90) = -0{\cdot}07$, $p > 0{\cdot}05$—and the decline of satiety was independent of the level after eating—between a_Q and b_Q, $r_S(52) = -0{\cdot}16$, $p > 0{\cdot}05$.

Meal ratings. Our modal subject rated the meal as "moderately liked", with none indicating strong dislike; he also rated the meal as a little less than he normally ate for lunch.

Gender differences. Comparison of median a_M, b_M, a_Q and b_Q by U-tests showed no reliable differences between the male subjects of Experiment 2 and the female subjects of Experiment 3 ($p > 0{\cdot}05$ for each comparison).

Number of cookies eaten. In Experiment 1, the mean number of cookies eaten in the 5 min following their presentation was 3·6, 3·0, and 2·8, for groups with zero, 5-min, and 10-min delays, respectively. A one-way analysis of variance showed no reliable differences, $F < 1$. The perceived satiety score immediately preceding the presentation of the cookies showed a non-significant rank-order correlation with number of cookies eaten ($r_S = +0{\cdot}22$, $z = 1{\cdot}43$, $p > 0{\cdot}05$).

Overweight and perceived satiety. Correlations were obtained between relative overweight scores and the constants for individual functions. [Relative overweight was defined as the difference between a subject's self-reported weight and the "ideal" weight, for a person of his self-reported weight and of medium frame, according to the Metropolitan Life Insurance Company norms (1959), expressed as a percentage of his self-reported weight. Overweight scores ranged from −9% to +63%; the median score was +10%, with a semi-interquartile range from +5·5 to +15·5.] Neither a_M, b_M, nor b_Q was reliably associated with relative overweight (r_S near zero, $p > 0{\cdot}05$ in each case).

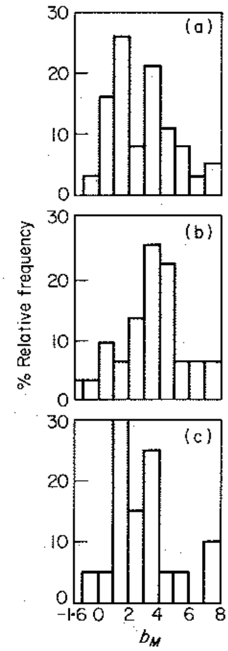

FIGURE 3. Percent frequency distributions of b_M, the rate constant for perceived satiety during a meal, for individual subjects ($n=90$), in three experiments.

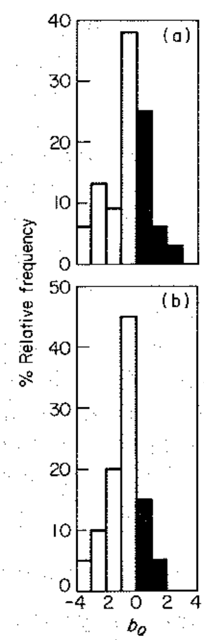

FIGURE 4. Percent frequency distributions of b_Q, the rate constant for perceived satiety after a meal, for individual subjects ($n=52$), in two experiments.

Discussion

Initial Settings

The question was posed in the Introduction whether hunger and satiety are inverse continua—more hungry means less sated—or are independent continua—hunger varies when satiety is zero, and satiety varies when hunger is zero. The matching behavior of 75 subjects who assigned a shorter length to "not full at all" than to "how full you are right now", or who assigned equal length, is consistent with either alternative. But the 19 subjects who assigned a *longer* length to "not full" seem to have been using that length to represent a neutral "neither full nor hungry", with larger lengths representing increasing satiety and shorter lengths increasing hunger: their matching behavior suggests that for them hunger and satiety are not simple inverses. The problem deserves empirical exploration to discover whether instructions that permit the subject to indicate first whether he is on the hungry or sated side of a neutral point, and then to scale the intensity of whichever state prevails, produce more consistent results.

Settings During and After the Meal

The length matches made by subjects give a clear picture of the changes in satiety that occur during and after this (relatively) normal meal. The most striking finding is how closely perceived satiety is tied to consummatory activity: as long as our subjects were eating, they felt themselves getting fuller, but soon after they stopped eating, they felt themselves getting less full. This confirms Jordan (1969), who reported that, when a meal was administered intragastrically, human subjects showed less change in satiety ratings than when ingestion was oral, indicating the importance of oral cues to growth in satiety. Although perceived satiety does fall after the meal, it does not fall immediately to zero, as it would if it depended only on consummatory activity; apparently perceived satiety is also dependent on internal events that persist after the meal.

These results are consistent with other studies that indicate the importance of sensory cues to eating. Le Magnen (1967), reviewing the research on feeding in non-primates, showed that consummatory behavior may be regarded as conditioned behavior, controlled by oropharyngeal stimuli accompanying feeding and reinforced by internal events following feeding.

To a first approximation, perceived satiety changes in a linear fashion with duration of meal and time from end of meal: however, our data are not sufficiently sensitive to discriminate between a linear function and curvilinear alternatives. If the constant rate of decrease after the meal were maintained, perceived satiety would reach its pre-meal level in 20 to 25 min for the average subject and would fall close to zero in 60 min. Our data do not rule out the possibility that perceived satiety decreases in a negatively-accelerated manner, so that zero satiety is not reached so rapidly.

Perceived Satiety and Termination of Ingestion

Our subjects probably do not normally rely on feelings of being very full to tell them to stop eating. Although the modal subject rated this meal as only a little less than the size normally eaten (almost half the subjects said it was the same or more), he reached only about 40% of maximum satiety during the meal. We may infer, then, that she or he usually stops eating lunch before becoming very full.

We had originally expected perceived satiety to increase after meal termination, and Experiment 1 asked whether intake of sweets would be depressed by this hypothesized rise. In the event, perceived satiety decreased after the meal, although slowly, and we might then have expected an increase in intake of sweets with increasing time after the meal. However, delay after the meal did not influence the number of cookies eaten, and the individual's level of satiety when cookies were presented was unrelated to number eaten. It should be remembered that most of our subjects did not approach maximum satiety (only three reached 70% of maximum, with a median of 40%). Under these conditions, factors such as assumed palatability of the cookies, subject's liking for them once tasted, and self-imposed limitations on the intake of sweets may account for most of the variability.

Perceived Satiety and Overweight

A perhaps surprising finding is the failure of relative overweight to be related to changes in perceived satiety. There is no support for the conjecture that overweight individuals eat more because they do not feel as full as normal weight individuals after the same food intake. Neither is there support for the hypothesis that feelings of satiety decrease more rapidly after the meal for overweight subjects. There are limitations on the generality of this conclusion. First, our sample did not include individuals who are extremely under- or overweight; such individuals might exhibit deviant satiety functions. Second, the test meal did not take the average level of satiety over 50%; differences associated with relative overweight might appear at higher levels. Third, the postprandial satiety function might reveal weight-associated differences at intervals longer than 10 min. Finally, a correlation between variables might be masked by lack of precision in the satiety function, which we cannot evaluate with only one score for each subject.

Suitability of the Technique to Scale Satiety

The relatively new psychophysical technique of cross-modal matching proved well-suited to the judging of perceived satiety. By providing an easy matching continuum, the length of a retractable metal tape, we could get frequent ratings while the subject was eating without interfering with his ongoing consummatory behavior. This study, and a recent study by Thompson and Campbell (1977), stand alone in providing measures of perceived satiety on a multi-valued scale over a period of time that included pre- and post-meal intervals. Both studies indicate that subjects are able to report about at least some aspects of the internal states related to food consumption.

The argument has been made in the Introduction that to question the subject's report of how full he feels would lead, by the same logic, to question a subject's report of weakening intensity in an adaptation procedure, or, for that matter, his report of how bright a light looks, or how loud a tone sounds, in a standard scaling experiment. There is a sense in which all such judgments are, by definition, valid: an observer's perceived magnitude is what he reports it to be. In the case of the more frequently-studied continua such as brightness and loudness, our confidence in subjects' judgments is enhanced by discovering the systematic way in which those judgments respond to physical variables that should exert an influence (signal amplitude, time in the dark, binaural versus monaural stimulation, etc.). In the case of perceived satiety it is difficult (though not impossible) to manipulate controlling variables in a way that would ensure judgments free of all expectation effects. Nonetheless, there is no *a priori* reason to reject subject reports of perceived satiety, and the force of analogy with other perceptual continua argues in their favor.

Even if one accepts the validity of reports of subjective states, the question remains whether they are related in an interesting and informative way to other variables. The present study failed to discover any statistically significant relations among various aspects of the individual satiety functions, or between the individual satiety functions and characteristics such as relative overweight. This failure might stem from either of two causes. First, there may indeed be no relationship between, say, relative overweight and growth of perceived satiety during a meal. That is, the attractive hypothesis that subjects for whom satiety grows slowly eat more and thus become obese may simply be false. But, on the other hand, the reliability of the individual satiety functions may not be great enough for a true relationship to be exhibited. Determining the reliability of individual psychophysical functions presents a difficult problem. There is some evidence that rather large differences in the exponents of power functions relating perceived intensity to physical intensity are attributable to the individual, but other evidence suggests that the repeatability of individual exponents depends on mnemonic factors rather than on idiosyncratic sensory or perceptual characteristics (Teghtsoonian & Teghtsoonian, 1971). It is certainly a question for future research whether the differences among individuals in perceived satiety functions are reliable. If so, it will be possible to pursue further the question of whether individual differences in perceived satiety can account for differences in food intake.

Yet, even if individual differences are not reliable—that is, if all individuals show about the same growth rate of perceived satiety under the same circumstances (much as all individuals show the same dark adaptation curve as time in the dark progresses)—perceived satiety may be sensitive in most subjects to such variables as amount of food consumed or amount of consummatory behavior, and may in turn influence the subject's food intake. Thus, the absence of large and reliable individual differences in a normal population does not lessen the potential value of a psychophysical assessment of perceived satiety. The present measure—cross-modal matching of length to satiety—has provided a fairly fine-grained description of changes in perceived satiety during and after a meal, and we suggest that it is a promising candidate for use in future research on the variables that control perceived satiety and the control that it may in turn exert on the initiation and termination of ingestion.

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Received 3 December, 1979; revision received 18 August, 1980.